

CLAIMS

I claim:

1. A shuttle blow molding machine comprising:

2 an extruder head located at a parison-receiving station;

3 a takeout mechanism located at an article-removal station, the parison-
4 receiving station and the article-removal station being located at spaced positions
5 along a horizontal workstation path;

6 first and second groups of mold units, wherein each of the mold units has a
7 carriage, clamp, mold, and blow pin assembly, the mold including a pair of mold
8 halves located in the clamp with the mold being movable by the clamp between an
9 open position, in which the mold halves are spaced from each other, and a closed
10 position, in which the mold halves are mated together to define one or more mold
11 cavities, the blow pin assembly being supported by the clamp and including one or
12 more blow pins that are movable between a retracted position away from the mold
13 and an inserted position in which the one or more blow pins are inserted into one or
14 more corresponding holes within the mold to deliver pressurized gas to the one or
15 more mold cavities, the clamp being mounted on the carriage with the carriage being
16 movable in a direction transverse to the horizontal workstation path such that the
17 mold can reciprocate between a retracted position, in which the mold is spaced from
18 the workstation path, and an extended position, in which the mold is centered along
19 the workstation path;

20 the mold units within the first group being located in side-by-side relation
21 adjacent each other and being movable as a group along a first path that is parallel to
22 the workstation path, the mold units within the second group being located in side-by-
23 side relation adjacent each other and being movable as a group along a second path
24 that is parallel to the workstation path, with the first and second groups of mold units
25 being located on opposite sides of the workstation path.

1 2. A shuttle blow molding machine as defined in claim 1, wherein each group
3 of mold units is indexed along its parallel path among a number of different index
4 positions, at least some of which coincide with the parison-receiving and article-
removal stations.

1 3. A shuttle blow molding machine as defined in claim 2, wherein the carriage
2 of each mold unit moves its associated mold between the retracted and extended
3 positions during indexing of the mold unit along its parallel path.

1 4. A shuttle blow molding machine as defined in claim 2, wherein, within
2 each group, the mold units are located along centerlines that are spaced by a distance
3 equal to the distance between adjacent index positions.

1 5. A shuttle blow molding machine as defined in claim 1, wherein the mold
2 units of each group are spaced from the other mold units in the same group by a
3 distance that is adjustable.

1 6. A shuttle blow molding machine as defined in claim 1, wherein the carriage
2 of each mold unit is independently movable in the transverse direction relative to the
3 other carriages, whereby each mold can move into and out of the workstation path
4 independently of the other molds.

1 7. A shuttle blow molding machine as defined in claim 1, wherein each mold
2 unit includes its own individual base.

1 8. A shuttle blow molding machine as defined in claim 7, wherein each mold
2 unit further comprises carriage slides mounted on the base, with the carriage being
3 mounted on the carriage slides for reciprocal movement of its associated mold
4 between the retracted and extended positions.

1 9. A shuttle blow molding machine as defined in claim 8, wherein each
2 carriage is movable upwardly towards the workstation path along an inclined path.

1 10. A shuttle blow molding machine as defined in claim 7, wherein the mold
2 units of each group are connected to the other mold units in the same group by
3 connecting their bases together to form a tram that moves as a single unit along its
4 parallel path.

1 11. A shuttle blow molding machine as defined in claim 1, further comprising
2 first and second indexers connected to the first and second groups of mold units,

3 respectively, wherein each of the indexers is operable to index its associated group of
4 mold units along its parallel path.

1 12. A shuttle blow molding machine as defined in claim 11, further
2 comprising a controller connected to the takeout mechanism, indexers, and mold
3 units, the controller being operable to coordinate operation of the takeout mechanism,
4 indexers, carriage, clamps, and blow pin assemblies.

1 13. A shuttle blow molding machine as defined in claim 12, wherein the
2 controller is operable to advance the mold units through repetitive cycles in which the
3 mold units of the first and second groups are indexed in a forward direction along
4 their respective paths from a starting position, through the article-removal and
5 parison-receiving stations, to a end position, and then are moved in a return direction
6 along their respective paths from the end position back to the starting position,
7 wherein, when the mold units are moving in the forward direction, the molds are
8 moved from their retracted position toward their extended position prior to entering
9 the article-removal station and then are moved back to their retracted position after
10 leaving the parison-receiving station, and wherein the mold units of the first group are
11 indexed together sequentially through the stations followed by the mold units of the
12 second group which are indexed together sequentially through the stations while the
13 mold units of the first group return to their starting position.

1 14. A shuttle blow molding machine as defined in claim 1, wherein said
2 takeout mechanism includes an article gripper, vertical slide, and horizontal transfer
3 mechanism, wherein the article gripper is supported by the vertical slide, with the
4 takeout mechanism being operable to lower the article gripper to an article-pickup
5 position where the article gripper is operable to engage a blow molded article located
6 in one of the molds, then raise the article gripper along with the removed article to an
7 upper, intermediate position, and then horizontally move the article to an article-
8 release position using the horizontal transfer mechanism.

1 15. A shuttle blow molding machine as defined in claim 14, further
2 comprising a conveyor located at the article-release position, wherein the horizontal
3 transfer mechanism is operable to release the article onto the conveyor at the article-

4 release position, and the conveyor is operable to carry the article away from the
5 takeout mechanism for subsequent processing.

1 16. A shuttle blow molding machine as defined in claim 1, wherein the blow
2 molding machine includes m workstations spaced along the workstation path
3 including at least the parison-receiving station and the article-removal station, and
4 wherein each of the first and second groups of mold units include n mold units in each
5 group, with each group of mold units indexing along its parallel path among at least
6 $2(n-1)+m$ index positions.

1 17. A shuttle blow molding machine comprising:
2 an extruder head located at a parison-receiving station;
3 a takeout mechanism located at an article-removal station, the parison-
4 receiving station and the article-removal station being located at spaced positions
5 along a workstation path;
6 first and second groups of mold units, wherein the first and second groups are
7 located on opposite sides of the workstation path and wherein each of the mold units
8 includes a mold that is movable in a direction transverse to the workstation path such
9 that the mold can reciprocate between a retracted position, in which the mold is
10 spaced from the workstation path, and an extended position, in which the mold is
11 centered along the workstation path;
12 first and second indexers connected to the first and second groups of mold
13 units, respectively, wherein each of the indexers is operable to move its associated
14 group of mold units together along a path that is parallel to the workstation path; and
15 a controller connected to the mold units and indexers, the controller being
16 operable to provide control signals to the mold units to control movement of the
17 molds between the extended and retracted positions and being operable to provide
18 control signals to the indexers to control movement of the groups of mold units along
19 the parallel paths;

20 wherein the controller is operable to advance the mold units through repetitive
21 cycles in which the mold units of the first and second groups are indexed in a forward
22 direction along their respective paths from a starting position, through the article-
23 removal and parison-receiving stations, to a end position, and then are moved in a
24 return direction along their respective paths from the end position back to the starting

25 position, wherein, when the mold units are moving in the forward direction, the molds
26 are moved from their retracted position toward their extended position prior to
27 entering the article-removal station and then are moved back to their retracted position
28 after leaving the parison-receiving station, and wherein the mold units of the first
29 group are indexed together sequentially through the stations followed by the mold
30 units of the second group which are indexed together sequentially through the stations
31 while the mold units of the first group return to their starting position.

1 18. A shuttle blow molding machine as defined in claim 17, wherein each of
2 the mold units includes a carriage, clamp, and blow pin assembly, the mold including
3 a pair of mold halves located in the clamp with the mold being movable by the clamp
4 between an open position, in which the mold halves are spaced from each other, and a
5 closed position, in which the mold halves are mated together to define one or more
6 mold cavities, the blow pin assembly being supported by the clamp and including one
7 or more blow pins that are movable between a retracted position away from the mold
8 and an inserted position in which the one or more blow pins are inserted into one or
9 more corresponding holes within the mold to deliver pressurized gas to the one or
10 more mold cavities, the clamp being mounted on the carriage with the carriage being
11 movable in the transverse direction such that the mold can reciprocate between its
12 retracted and extended positions.

1 19. A shuttle blow molding machine as defined in claim 18, wherein the
2 carriage of each mold unit moves its associated mold between the retracted and
3 extended positions during indexing of the mold unit along its parallel path.

1 20. A shuttle blow molding machine as defined in claim 18, wherein the
2 controller is connected to the takeout mechanism, indexers, and mold units, the
3 controller being operable to coordinate operation of the takeout mechanism, indexers,
4 carriage, clamps, and blow pin assemblies.

1 21. A shuttle blow molding machine as defined in claim 17, wherein the mold
2 units within the each group are located in side-by-side relation adjacent each other
3 and are movable as a group along their parallel path.

1 22. A shuttle blow molding machine as defined in claim 17, wherein, within
2 each group, the mold units are located along centerlines that are spaced by a distance
3 equal to the distance between adjacent workstations.

1 23. A shuttle blow molding machine as defined in claim 17, wherein the mold
2 units of each group are spaced from the other mold units in the same group by a
3 distance that is adjustable.

4 24. A shuttle blow molding machine as defined in claim 17, wherein each
5 mold is independently movable relative to the other molds between its retracted and
6 extended positions.

1 25. A shuttle blow molding machine as defined in claim 17, wherein each
2 mold unit includes its own individual base.

1 26. A shuttle blow molding machine as defined in claim 25, wherein each
2 mold unit further comprises carriage slides mounted on the base, with the mold being
3 supported on the carriage slides for reciprocal movement between the retracted and
4 extended positions.

1 27. A shuttle blow molding machine as defined in claim 26, wherein each
2 mold is movable upwardly towards the workstation path along an inclined path.

1 28. A shuttle blow molding machine as defined in claim 25, wherein the mold
2 units of each group are connected to the other mold units in the same group by
3 connecting their bases together to form a tram that moves as a single unit along its
4 parallel path.

1 29. A shuttle blow molding machine as defined in claim 17, wherein the
2 controller is operable to advance the mold units through repetitive cycles in which the
3 mold units of the first and second groups are indexed in a forward direction along
4 their respective paths from a starting position, through the article-removal and
5 parison-receiving stations, to a end position, and then are moved in a return direction
6 along their respective paths from the end position back to the starting position,
7 wherein, when the mold units are moving in the forward direction, the molds are
8 moved from their retracted position toward their extended position prior to entering

9 the article-removal station and then are moved back to their retracted position after
10 leaving the parison-receiving station, and wherein the mold units of the first group are
11 indexed together sequentially through the stations followed by the mold units of the
12 second group which are indexed together sequentially through the stations while the
13 mold units of the first group return to their starting position.

1 30. A shuttle blow molding machine as defined in claim 17, wherein said
2 takeout mechanism includes an article gripper, vertical slide, and horizontal transfer
3 mechanism, wherein the article gripper is supported by the vertical slide, with the
4 takeout mechanism being operable to lower the article gripper to an article-pickup
5 position where the article gripper is operable to engage a blow molded article located
6 in one of the molds, then raise the article gripper along with the removed article to an
7 upper, intermediate position, and then horizontally move the article to an article-
8 release position using the horizontal transfer mechanism.

1 31. A shuttle blow molding machine as defined in claim 30, further
2 comprising a conveyor located at the article-release position, wherein the horizontal
3 transfer mechanism is operable to release the article onto the conveyor at the article-
4 release position, and the conveyor is operable to carry the article away from the
5 takeout mechanism for subsequent processing.

1 32. A shuttle blow molding machine as defined in claim 17, wherein the blow
2 molding machine includes m workstations spaced along the workstation path
3 including at least the parison-receiving workstation and the article-removal
4 workstation, and wherein each of the first and second groups of mold units include n
5 mold units in each group, with each group of mold units indexing along its parallel
6 path among at least $2(n-1)+m$ index positions.

1 33. A shuttle blow molding machine comprising:
2 m workstations spaced along a horizontal workstation path, the workstations
3 including at least a parison-receiving station and an article-removal station; and
4 first and second groups of mold units, wherein the first and second groups
5 each have n mold units and are located on opposite sides of the workstation path, each
6 of the mold units including a mold that is movable in a direction transverse to the
7 workstation path such that the mold can reciprocate between a retracted position, in

8 which the mold is spaced from the workstation path, and an extended position, in
9 which the mold is centered along the workstation path;

10 wherein each group of mold units indexes along a path parallel to the
11 workstation path among at least $2(n-1)+m$ index positions.

1 34. A shuttle blow molding machine as defined in claim 33, wherein each of
2 the mold units includes a carriage, clamp, and blow pin assembly, the mold including
3 a pair of mold halves located in the clamp with the mold being movable by the clamp
4 between an open position, in which the mold halves are spaced from each other, and a
5 closed position, in which the mold halves are mated together to define one or more
6 mold cavities, the blow pin assembly being supported by the clamp and including one
7 or more blow pins that are movable between a retracted position away from the mold
8 and an inserted position in which the one or more blow pins are inserted into one or
9 more corresponding holes within the mold to deliver pressurized gas to the one or
10 more mold cavities, the clamp being mounted on the carriage with the carriage being
11 movable in the transverse direction such that the mold can reciprocate between its
12 retracted and extended positions.

1 35. A shuttle blow molding machine as defined in claim 34, wherein the
2 carriage of each mold unit moves its associated mold between the retracted and
3 extended positions during indexing of the mold unit along its parallel path.

1 36. A shuttle blow molding machine as defined in claim 34, further
2 comprising a controller connected to the takeout mechanism, indexers, and mold
3 units, the controller being operable to coordinate operation of the takeout mechanism,
4 indexers, carriage, clamps, and blow pin assemblies.

1 37. A shuttle blow molding machine as defined in claim 33, wherein the mold
2 units within the each group are located in side-by-side relation adjacent each other
3 and are movable as a group along their parallel path.

1 38. A shuttle blow molding machine as defined in claim 33, wherein, within
2 each group, the mold units are located along centerlines that are spaced by a distance
3 equal to the distance between adjacent workstations.

1 39. A shuttle blow molding machine as defined in claim 33, wherein the mold
2 units of each group are spaced from the other mold units in the same group by a
3 distance that is adjustable.

1 40. A shuttle blow molding machine as defined in claim 33, wherein each
2 mold is independently movable relative to the other molds between its retracted and
3 extended positions.

1 41. A shuttle blow molding machine as defined in claim 33, wherein each
2 mold unit includes its own individual base.

1 42. A shuttle blow molding machine as defined in claim 41, wherein each
2 mold unit further comprises carriage slides mounted on the base, with the mold being
3 supported on the carriage slides for reciprocal movement between the retracted and
4 extended positions.

1 43. A shuttle blow molding machine as defined in claim 42, wherein each
2 mold is movable upwardly towards the workstation path along an inclined path.

1 44. A shuttle blow molding machine as defined in claim 41, wherein the mold
2 units of each group are connected to the other mold units in the same group by
3 connecting their bases together to form a tram that moves as a single unit along its
4 parallel path.

1 45. A shuttle blow molding machine as defined in claim 33, further
2 comprising first and second indexers connected to the first and second groups of mold
3 units, respectively, wherein each of the indexers is operable to index its associated
4 group of mold units along its parallel path.

1 46. A shuttle blow molding machine as defined in claim 45, further
2 comprising a controller that is operable to provide control signals to the mold units to
3 control movement of the molds between the extended and retracted positions and that
4 is operable to provide control signals to the indexers to control movement of the
5 groups of mold units along the parallel paths.

1 47. A shuttle blow molding machine as defined in claim 46, wherein the
2 controller is operable to advance the mold units through repetitive cycles in which the
3 mold units of the first and second groups are indexed in a forward direction along
4 their respective paths from a starting position, through the article-removal and
5 parison-receiving stations, to a end position, and then are moved in a return direction
6 along their respective paths from the end position back to the starting position,
7 wherein, when the mold units are moving in the forward direction, the molds are
8 moved from their retracted position toward their extended position prior to entering
9 the article-removal station and then are moved back to their retracted position after
10 leaving the parison-receiving station, and wherein the mold units of the first group are
11 indexed together sequentially through the stations followed by the mold units of the
12 second group which are indexed together sequentially through the stations while the
13 mold units of the first group return to their starting position.

1 48. A shuttle blow molding machine as defined in claim 33, wherein said
2 takeout mechanism includes an article gripper, vertical slide, and horizontal transfer
3 mechanism, wherein the article gripper is supported by the vertical slide, with the
4 takeout mechanism being operable to lower the article gripper to an article-pickup
5 position where the article gripper is operable to engage a blow molded article located
6 in one of the molds, then raise the article gripper along with the removed article to an
7 upper, intermediate position, and then horizontally move the article to an article-
8 release position using the horizontal transfer mechanism.

1 49. A shuttle blow molding machine as defined in claim 48, further
2 comprising a conveyor located at the article-release position, wherein the horizontal
3 transfer mechanism is operable to release the article onto the conveyor at the article-
4 release position, and the conveyor is operable to carry the article away from the
5 takeout mechanism for subsequent processing.

1 50. A shuttle blow molding machine as defined in claim 33, wherein each
2 group of mold units indexes along its parallel path among $2n+m$ index positions.